Using Maximal Isometric Force to Determine the Optimal Load for Measuring Dynamic Muscle Power

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Abstract

Maximal power output typically occurs when subjects perform ballistic exercises using loads of ~30% of one-repetition maximum (1-RM). However, performing 1-RM testing prior to power measurement requires considerable time, especially when testing involves multiple exercises. Maximal isometric force (MIF), which requires substantially less time to measure than 1-RM, might be an acceptable alternative for determining the optimal load for power testing. PURPOSE: To determine the optimal load based on MIF for maximizing dynamic power output during leg press and bench press exercises. METHODS: Twenty healthy volunteers (12 men and 8 women; mean ± SD age: 31 ± 6 years; body mass: 72 ± 15 kg) performed isometric leg press and bench press exercises, during which MIF was measured using force plates. Subsequently, subjects performed ballistic leg press and bench press exercises using loads corresponding to 20%, 30%, 40%, 50%, 60%, and 60% of MIF measured in randomized order. Maximal instantaneous power was calculated during the ballistic exercise tests using force plates and position transducers. RESULTS: Leg press peak power output was highest during the 40% MIF attempt (effect size = 0.38). Although some controversy exists (2), peak instantaneous power output is maximized when athletes perform ballistic movements using loads corresponding to ~30% of 1-RM (1). However, measuring 1-RM is not always feasible/appropriate. For instance, 1-RM testing prior to power measurement requires considerable time, especially when subjects are tested using multiple exercises; and 1-RM testing might be contradicted in some populations (i.e., frail elderly, during injury rehabilitation, post-unloading).

Methods

Maximal isometric force (MIF) values are presented in Table 1. Through Table 1, it is observed that MIF values are highest at 40% of MIF. Therefore, 40% of MIF load is the optimal load for measuring dynamic muscle power. The optimal load for peak power output is 40% MIF and is supported in this study.

Results

Table 1. Maximal isometric force values (mean ± SD).

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<tr>
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<th>Leg Press (N)</th>
<th>Bench Press (N)</th>
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<tbody>
<tr>
<td>Females (n = 8)</td>
<td>398 ± 53</td>
<td>188 ± 50</td>
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<tr>
<td>Males (n = 12)</td>
<td>764 ± 130</td>
<td>427 ± 90</td>
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<td>Total (n = 20)</td>
<td>618 ± 212</td>
<td>331 ± 142</td>
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</table>

Conclusions

Maximal isometric force (MIF) requires less time and is inherently safe to perform, as it is used as an alternative strength measure for determining the optimal load for power testing.

References


Acknowledgements

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